CLAIMS:

What is claimed is:

1. A method of operating a thermal processing system comprising:

positioning a wafer for processing by the thermal processing system on a hotplate comprising a plurality of zones;

creating a dynamic thermal model of the thermal processing system;

establishing a plurality of intelligent setpoints using the dynamic thermal model of the thermal processing system, wherein each of the plurality of intelligent setpoints is associated with a corresponding one of the plurality of zones; and

controlling an actual temperature of each of the plurality of zones of the hotplate using a corresponding one of the plurality of intelligent setpoints to establish a substantially uniform temperature profile across the wafer during processing.

2. The method of claim 1 further comprising:

receiving feed forward data;

estimating wafer stresses using the feed forward data;

creating a thermal model for a gap between the wafer and the hotplate, wherein a thermal response for the gap is predicted based on the estimated wafer stresses; and

incorporating the thermal model for the gap into the dynamic thermal model of the system.

3. The method of claim 2 wherein wafer stresses are estimated using refractive index (n) data and extinction coefficient (k) data extracted from the feed forward data.

4. The method of claim 2 wherein the feed forward data comprises layer information including at least one of the number of layers, layer position, layer composition, layer uniformity, layer density, and layer thickness.

5. The method of claim 2 wherein the feed forward data includes at least one of critical dimension (CD) data, profile data, and uniformity data for the wafer.

6. The method of claim 2 wherein the feed forward data includes at least one of critical dimension (CD) data for a plurality of locations on the wafer, profile data for a plurality of locations on the wafer, and uniformity data for a plurality of locations on the wafer.

7. The method of claim 2 wherein the feed forward data includes a plurality of locations radially positioned on the wafer.

8. The method of claim 2 wherein the feed forward data includes a plurality of locations non-radially positioned on the wafer.

9. The method of claim 1 further comprising:

examining a real-time response of the wafer and the hotplate;

estimating wafer stresses using the real-time response; and

creating a thermal model for a gap between the wafer and the hotplate, wherein a thermal response for the gap is predicted based on the estimated wafer stresses; and

incorporating the thermal model for the gap into the dynamic thermal model of the system.

10. The method of claim 1 further comprising:

estimating wafer warpage; and

creating a thermal model for a gap between the wafer and the hotplate, wherein a thermal response for the gap is predicted based on the estimated wafer warpage; and

incorporating the thermal model for the gap into the dynamic thermal model of the system.

11. The method of claim 1 further comprising:

modeling a thermal interaction between the zones of the hotplate; and

incorporating the model of the thermal interaction into the dynamic thermal model of the system.

12. The method of claim 1 further comprising:

creating a virtual sensor for estimating a temperature for the wafer; and

incorporating the virtual sensor into the dynamic thermal model of the system.

13. The method of claim 1 further comprising:

modeling a thermal interaction between the hotplate and an ambient environment; and

incorporating the model for the thermal interaction into the dynamic thermal model of the system.

14. The method of claim 1 further comprising:

creating a diffusion-amplification model of a resist carried by the wafer; and

incorporating the diffusion-amplification model into the dynamic thermal model of the system.

15. The method of claim 1 wherein establishing the plurality of intelligent setpoints further comprises:

creating a variation vector D, wherein the variation vector comprises differences between measurement data and a desired value;

parameterizing at least one nominal setpoint into a vector R comprising at least one intelligent setpoint;

creating a sensitivity matrix using the dynamic thermal model; and

determining the at least one intelligent setpoint by solving an optimization problem comprising

$$\min_{r} \|D - \alpha \cdot MR\|,$$

wherein $r_{min} < r < r_{max}$, R is the vector comprising the at least one intelligent setpoint, M is the sensitivity matrix, α is a proportionality constant relating the measurement data to the sensitivity matrix M, and D is the variation vector.

16. The method of claim 15 further comprising:

updating a recipe with the plurality of intelligent setpoints;

running the updated recipe;

obtaining updated measurement data; and

iterating until a desired uniformity is achieved.

17. The method of claim 16 wherein the desired uniformity comprises a 3-sigma variation of less than approximately two percent.

18. The method of claim 17 wherein the desired uniformity comprises a 3-sigma variation of less than approximately one percent.

19. The method of claim 15 further comprising:

receiving feed forward data;

obtaining the measurement data from the feed forward data, wherein the measurement data comprises at least one of critical dimension measurements, profile measurements, and uniformity measurements; and

determining the desired value, wherein the desired value comprises at least one of desired critical dimension, a desired profile, and a desired uniformity.

20. The method of claim 15 further comprising:

executing a process using a recipe having at least one nominal setpoint for each zone of the hotplate;

obtaining the measurement data from the executed process, wherein the measurement data comprises at least one of critical dimension measurements, profile measurements, and uniformity measurements; and

determining the desired value, wherein the desired value comprises at least one of desired critical dimension, a desired profile, and a desired uniformity.

21. The method of claim 15 further comprising:

making temperature perturbations for each zone of the hotplate; and

establishing the sensitivity matrix *M* using results of the temperature perturbations.

22. The method of claim 15 further comprising:

using an instrumented wafer to establish the sensitivity matrix *M*.

23. The method of claim 15 further comprising:

determining a vector *D* of the thermal dose at each radial element location, wherein

$$D = \begin{bmatrix} d_1 \\ \vdots \\ d_n \end{bmatrix}; \text{ and}$$

characterizing the resultant perturbations in the thermal dose as

$$\begin{bmatrix} d_1 \\ \vdots \\ d_n \end{bmatrix} = M \begin{bmatrix} r_1 \\ \vdots \\ r_m \end{bmatrix}; \text{ and}$$

determining values of vector r, such that the resultant d removes the across wafer variations in the variation vector *D*.